



Low-Cost Cruise Missile Defense (LCCMD)

Tim Clark

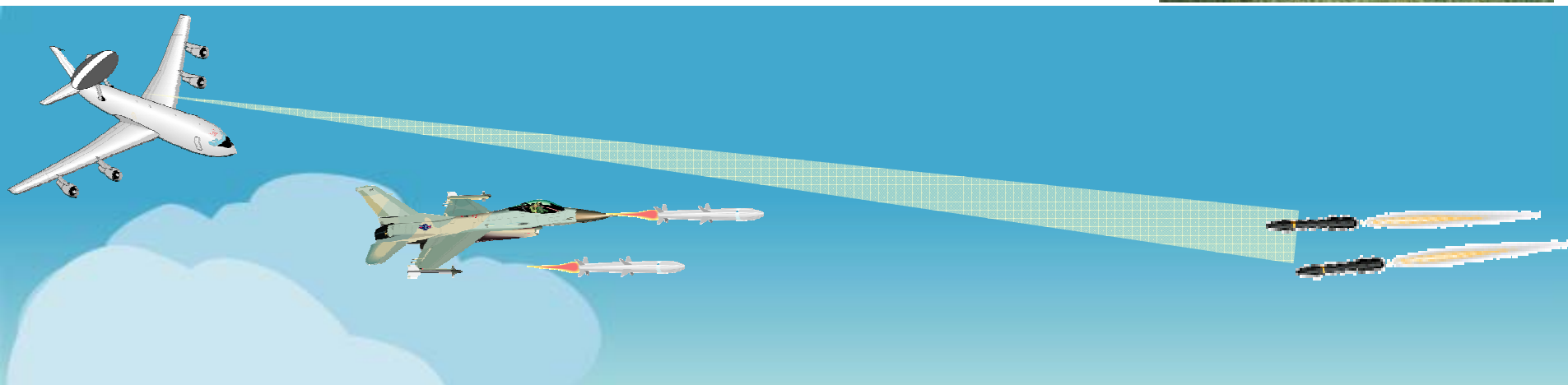
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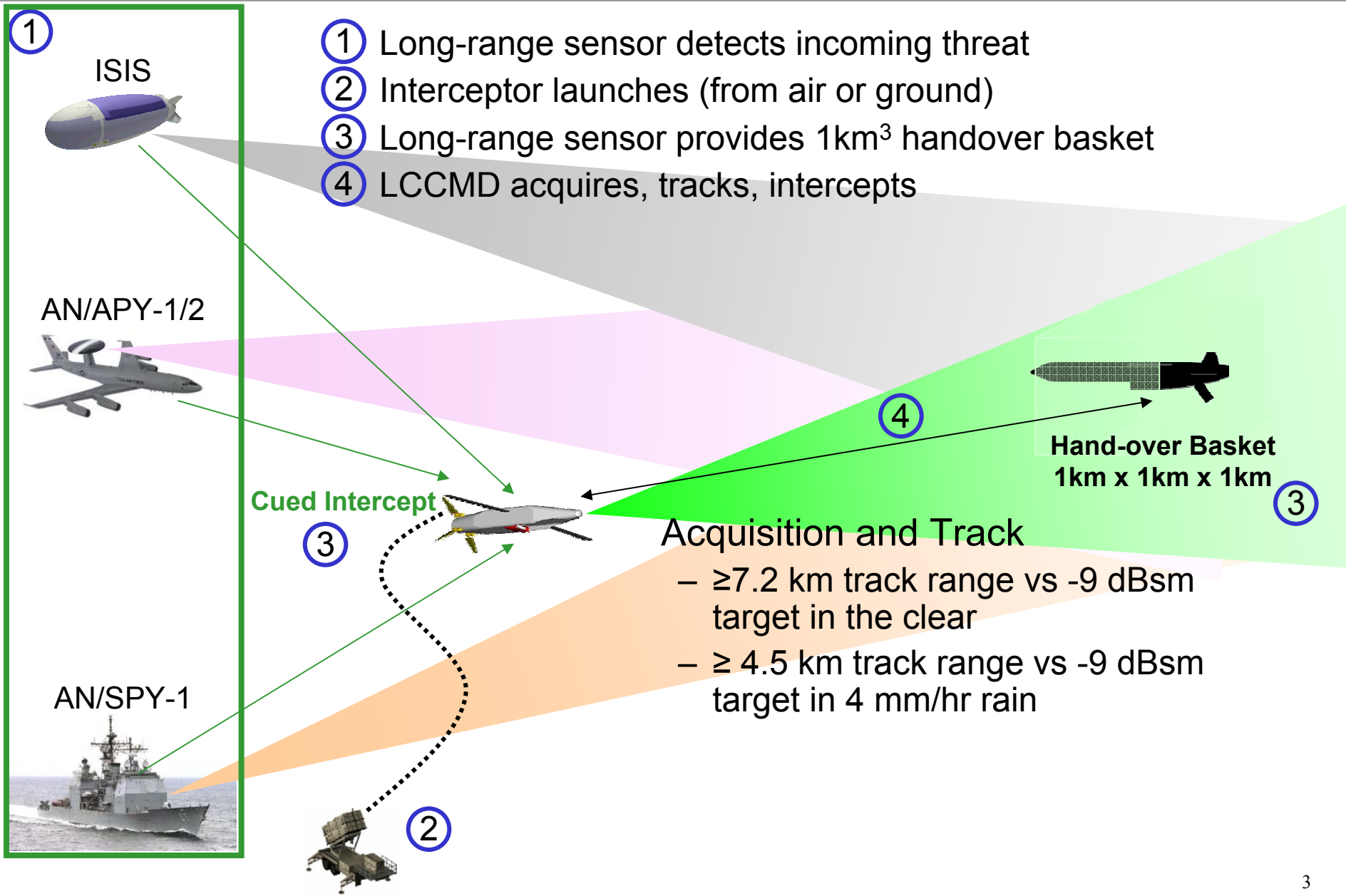
Low Cost Cruise Missile Defense (LCCMD)



- Problem:
 - Highly proliferated, low-cost/low-tech cruise missiles or other airframes delivering conventional or chem/bio warheads
 - Current interceptors are:
 - designed for small numbers of sophisticated threats
 - costly
 - don't have range for chem/bio threat
- Desired Solution:
 - Long range (>100km) intercept for chem/bio threat
 - Used with existing or emerging launchers and radars
 - Low-cost (\$100k)



Concept of Operations



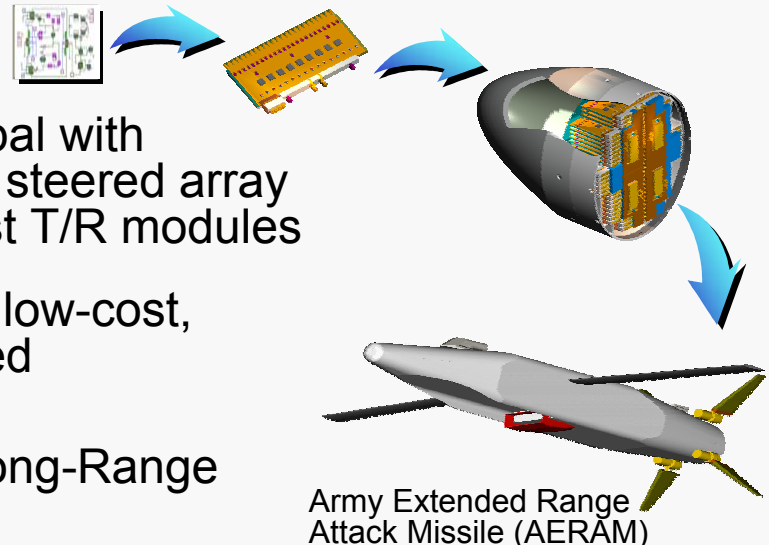
Cost is the Driving Design Factor

Interceptor comparison

	Target	Range	Speed	Seeker	Unit Cost
PAC-3 (ground-to-air)	Tactical ballistic missiles	15 km	Mach = 5	Active	\$3,875k (FY02 \$)
PAC-1 (ground-to-air)	Fighter Aircraft	70 km	Mach = 3	Semi-active	\$893k (FY02 \$)
AMRAAM (air-to-air)	Fighter Aircraft Cruise missiles	40 km	Mach = 4	Active	\$524k (FY02 \$)
LCCMD	Aircraft Cruise missiles	300+ km	Mach = 0.9	Active	\$100k (FY02 \$)

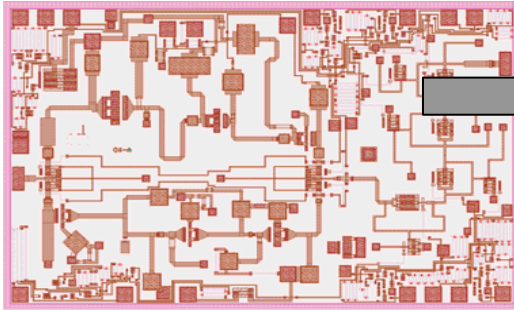
LCCMD cost breakdown

Antenna	\$19k	←	Replace gimbal with electronically steered array using low cost T/R modules
Electronics	\$21k	←	Use modern, low-cost, chip-integrated electronics
LCCMD	<u>\$60k</u>	←	Affordable Long-Range Interceptor
	\$100k		



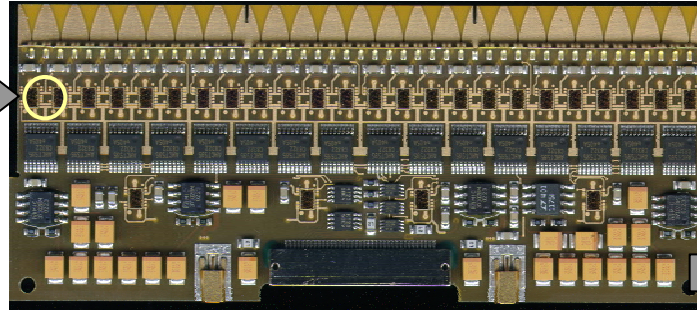
Built and Tested Ka-Band Active ESA

T/R MMIC



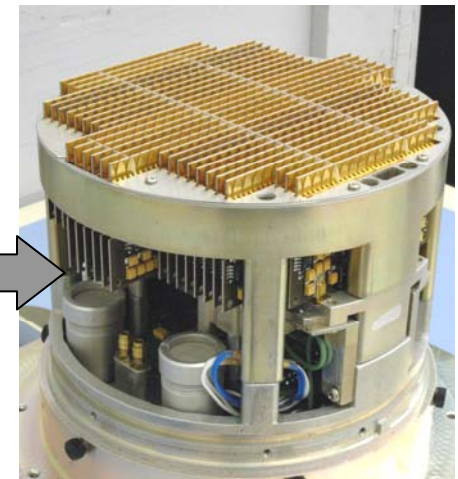
6 Wafers fabricated
1158 MMICs needed
1406 MMICs completed

Transmit Receive Integrated Microwave Module (TRIMM)



16 Element: 6 + 3 spares
24 Element: 16 + 3 spares
32 Element: 6 + 2 spares

Assembled and Tested AESA



$$\text{FOM} = P_t * G / F_n$$

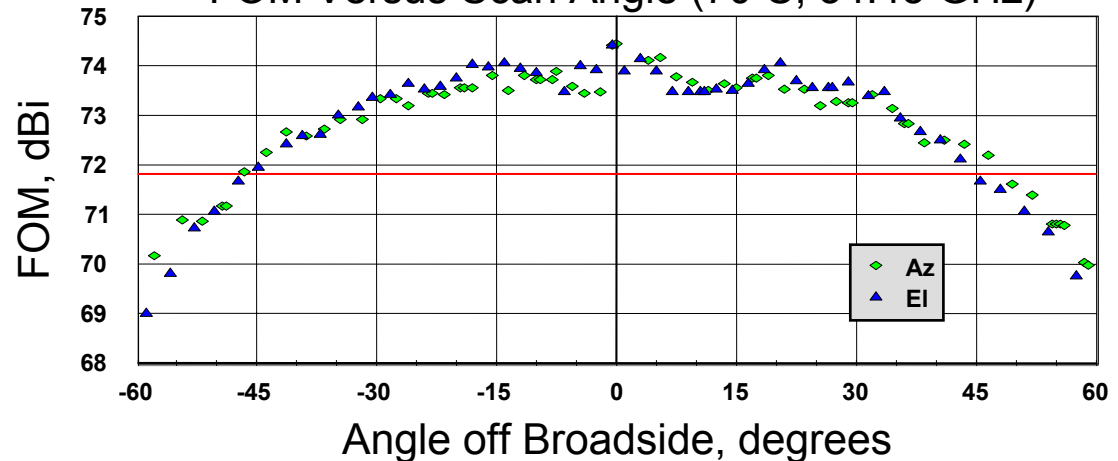
P_t = Transmit power, dBm

G = Gain, dB

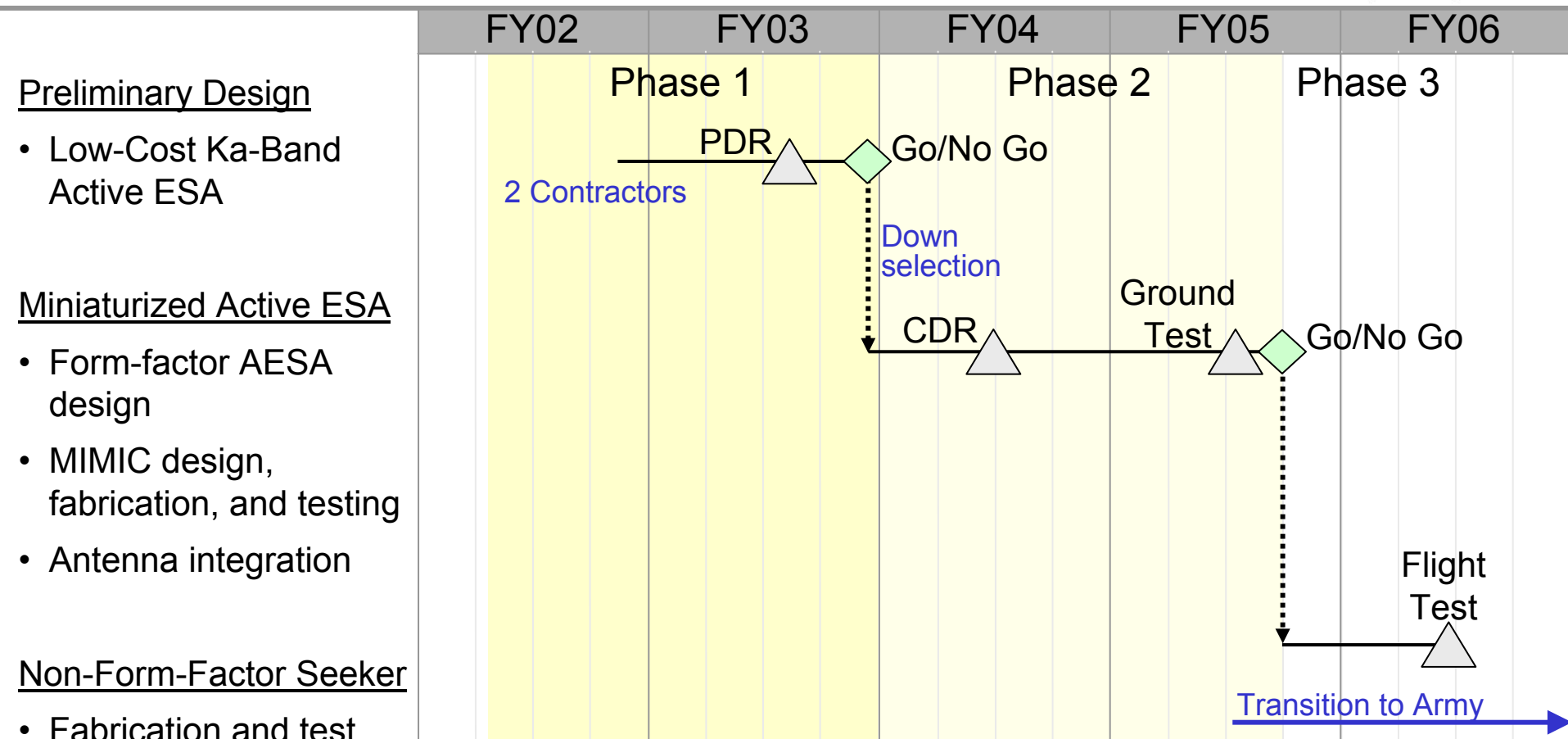
F_n = Noise Figure, dB

Required	> 71.8 dBm
Measured	74.5 dBm

FOM Versus Scan Angle (70 C; 34.45 GHz)



LCCMD Schedule



- FY06 Plans

- Build non-form factor seeker electronics and perform captive flight test
- Transition to Army for integration into missile seeker developments